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PART VI

AIRCRAFT GROUND-FLOTATION INVESTIGATION
PART VI DATA REPORT ON TEST SECTION 5

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U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

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AIR FORCE FLIGHT DYNAMICS LABORATORY
RESEARCH AND TECHNOLOGY DIVISION
AIR FORCE SYSTEMS COMMAND
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PART VI DATA REPORT ON TEST SECTION 5

W. BRABSTON and W. HILL, JR.

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FOREWORD

The investigation described herein constitutes one phase of studies conducted during 1964 and 1965 at the U. S. Army Engineer Waterways Experiment Station (WES) under U. S. Air Force Project No. 410-A, MIPR No. AS-4-177, "Development of Landing Gear Design Criteria for the CX-HLS Aircraft." (The CX-HLS is now designated C-5A.) This program was sponsored and directed by the Landing Gear Group, Air Force Flight Dynamics Laboratory, Research and Technology Division, Mr. R. J. Parker, Project Engineer.

These tests were conducted by personnel of the WES Flexible Pavement Branch, Soils Division, under the general supervision of Messrs. W. J. Turnbull, A. A. Maxwell, and R. G. Ahlvin, and the direct supervision of Mr. D. N. Brown. Other personnel actively engaged in this study were Messrs. C. D. Burns, D. M. Ladd, W. N. Brabston, A. H. Rutledge, H. H. Ulery, Jr., A. J. Smith, Jr., and W. J. Hill, Jr. This report was prepared by Messrs. Brabston and Hill.

Directors of WES during the conduct of this investigation and preparation of this report were Col. Alex G. Sutton, Jr., CE, and Col. John R. Oswalt, Jr., CE. Technical Director was Mr. J. B. Tiffany.

Publication of this technical documentary report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

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ABSTRACT

This data report describes work undertaken as part of an overall program to develop ground-flotation criteria for the C-5A aircraft. A test section was constructed to a width adequate for two test lanes. Each lane was divided into three items having different subgrade CBR values and different traffic surfaces. Item 1 was surfaced with modified T11 aluminum landing mat, item 2 with M8 steel landing mat, and item 3 was unsurfaced. Traffic was applied using a 140,000-lb test load with a twin-twin wheel configuration on one lane and a twin-tandem wheel configuration on the other lane. The twin-twin wheel spacings were 37-68-37 in. c-c and the twin-tandem spacings were 37-in. c-c twin, 60-in. c-c tandem. Each assembly consisted of four 56x16, 24-ply aircraft tires with an inflation pressure of 100 psi.

This report presents the data collected on soil strengths, surface deformations and deflections, and drawbar pull. The traffic-coverage level at which failure was evidenced on each test item is also given.

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SUMMARY

Tests on Section 5 are one phase of a comprehensive research program to develop ground-flotation criteria for heavy cargo-type aircraft. Section 5 consisted of two similar traffic lanes, lanes 9 and 10, each of which was divided into three items (figure 20). Each item was constructed to a different subgrade CBR value and had a different traffic surface. Item 1 was surfaced with modified T11 aluminum landing mat, item 2 with M8 steel landing mat, and item 3 remained unsurfaced.

Traffic was applied to the two lanes using a 140,000-lb test load with a twin-twin wheel configuration and a twin-tandem wheel configuration for lanes 9 and 10, respectively. The wheel spacings were 37-68-37 in. c-c for lane 9 and 37-in. c-c twin, 60-in. c-c tandem for lane 10. Each assembly consisted of four 56x16, 24-ply aircraft tires with inflation pressure of 100 psi. Figure 22 gives pertinent dimensions and tire characteristics for both assemblies.

The lanes were trafficked to failure in accordance with the criteria designated in Part I of this report. Data were recorded throughout testing to give a behavior history of each item.

Using the test criteria mentioned above, it was possible to directly compare the effects of trafficking with the two assemblies. Basic performance data are summarized in the following paragraphs.

Lane 9

Item 1

Item 1 was considered failed due to roughness at 199 coverages. The rated CBR for the item was 2.4.

Item 2

Item 2 was considered failed due to roughness at 102 coverages. The rated CBR for the item was 4.1.

Item 3

Item 3 was considered failed due to excessive rutting at 20 coverages. The rated CBR for the item was 9.8.

Lane 10

Item 1

Item 1 was considered failed due to roughness at 74 coverages. The rated CBR for the item was 2.6.

Item 2

Item 2 was considered failed due to roughness at 48 coverages. The rated CBR for the item was 4.0.

Item 3

Item 3 was considered failed due to roughness at 24 coverages. The rated CBR for the item was 9.8.

AIRCRAFT GROUND-FLOTATION INVESTIGATION

PART VI DATA REPORT ON TEST SECTION 5

SECTION I: INTRODUCTION

The investigation reported herein is one phase of a comprehensive research program being conducted at the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., as part of U. S. Air Force Project No. 410-A, MIPR No. AS-4-177, to develop ground-flotation criteria for the C-5A, a heavy cargo-type aircraft. Specifically, the tests reported herein are part of a series of tests to determine the degree of interaction of the wheels of multiple-wheel landing-gear assemblies on landing mat and unsurfaced soils under various conditions of loading.

Prosecution of this investigation consisted of constructing two similar traffic lanes and subjecting them to equal test loads with twin-twin and twin-tandem landing-gear assemblies.

This report presents a description of the test section and wheel assemblies, and gives results of traffic. Equipment used, types of data and method of recording them, and general test criteria are explained and illustrated in Part I of this report.

SECTION II: DESCRIPTION OF TEST SECTION AND LOAD VEHICLES

Description of Test Section

The test section (figure 20) was constructed within a roofed area in order to allow control of the subgrade CBR (California Bearing Ratio) in the test items. Section 5 was located on the same site as Test Section 3 of this series, the construction of which is described in Part IV of this report. The underlying subgrade was undisturbed by tests on Section 3 so that only the upper 18 in. of soil was excavated for construction of Section 5. The excavated area was backfilled to the original grade level in compacted lifts with a heavy clay soil (buckshot; classified as CH according to the Unified Soil Classification System, MIL-STD-619). The fill material used was a local clay with a plastic limit of 27, liquid limit of 58, and plasticity index of 31. Gradation and classification data for the subgrade material are given in Part I.

Two traffic lanes, each divided into three items, were constructed in the test section. Different subgrade strengths were obtained in the items (figure 20) by controlling the water content and compaction effort. Items 1 and 2 were surfaced with modified T11 aluminum and M8 steel landing mat, respectively (figure 21). Item 3 remained unsurfaced. The landing mats used are described and illustrated in Part I.

Load Vehicles

The load vehicles used in tracking Section 5 are shown in figures 2 and 3 for lanes 9 and 10, respectively. For trafficking both lanes the load compartments were weighted to 140,000 lb. On lane 9 a twin-twin wheel assembly spaced 37-68-37 in. c-c was used and on lane 10 a twin-tandem assembly was used with spacings 37-in. c-c twin, 60-in. c-c tandem. Each assembly consisted of four 56x16, 24-ply aircraft tires with inflation pressure of 100 psi. Tire-print data and pertinent tire characteristics are given in figure 22.

SECTION III: APPLICATION OF TRAFFIC, FAILURE CRITERIA, AND DATA OBTAINED

Application of Traffic

The load vehicles were operated to produce uniform traffic coverage on the test lanes. Each load cart was driven forward and backward along the same track longitudinally along the respective test lanes, then shifted laterally and the forward-backward operation repeated. Figure 1 shows the general method of applying uniform coverages to the test lanes. Typically, the lane widths used were not exact multiples of the tracking tire widths and spacings so that it was necessary to determine a coverage factor for each lane to compensate for overlaps or gaps in the traffic pattern. Coverage factors were 1.13 and 1.20 for lanes 9 and 10, respectively. In all cases, the coverage levels indicated in the text and tables herein represent the corrected coverage levels.

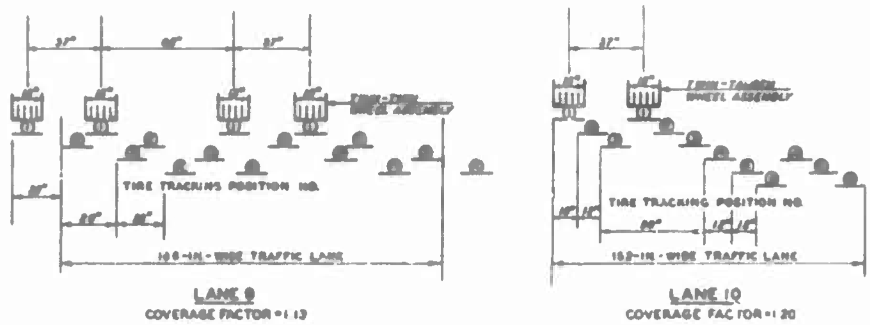

Figure 1. Sequence of traffic application for uniform coverages

Failure Criteria and Data Obtained

Failure criteria used in this investigation and descriptive terms used in presentation and discussion of data in all parts of this report are presented in Part I. A general outline of types of data collected is given in the following paragraphs. Details on apparatus and procedure for obtaining specific measurements are given in Part I.

CBR, water content, and dry density

CBR, water content, and dry density of the subgrade were measured for each test item prior to application of traffic, at intermediate coverage levels, and at failure. After traffic was concluded on an item, a measure of subgrade strength termed "rated CBR" was determined. Rated CBR is generally the average CBR value obtained from all the determinations made in the top 12 in. of soil during the test life of an item. In certain instances,

extreme or irregular values may be ignored if the analyst decides that they are not properly representative.

Surface roughness, or differential deformation

Surface roughness, or differential deformation, measurements were made using a 10-ft straightedge at various traffic-coverage levels on all items. Rut depths were measured for unsurfaced items, and dishing effects of individual mat panels in the mat-surfaced items were recorded.

Deformations

Deformations, defined as permanent cumulative surface changes in cross section or profile of an item, were charted by means of level readings at pertinent traffic-coverage levels.

Deflection

Deflection of the test surface under an individual static load of the tracking assembly was measured at various traffic-coverage levels on both surfaced and unsurfaced items. Level readings on the item surface on each side of the load wheels and on a pin and cap device directly beneath a load wheel provided deflection data. Both total (for a single loading) and elastic (recoverable) deflections were measured on unsurfaced items. All mat deflection was for practical purposes recoverable, i.e. total deflection equaled elastic (spring-back) deflection. The pin and cap device for measuring deflection directly beneath load wheels was applied to the subgrade of surfaced items through a hole (existing or cut) in the mat.

Rolling resistance

Rolling resistance, or drawbar pull, measurements were performed with the load vehicle over each test item at designated coverage levels. Three types of drawbar measurements were taken: (a) maximum force required to overcome static inertia and commence forward movement of the load cart, termed "initial DBP"; (b) average force required to maintain a constant speed once the load vehicle is in motion, termed "rolling DBP"; and (c) maximum force obtained during the constant speed run, termed "peak DBP."

Mat breaks

Mat breaks on the surfaced items were inspected, classified by type, and recorded at various coverage levels.

SECTION IV: BEHAVIOR OF ITEMS UNDER TRAFFIC AND TEST RESULTS

Lane 9

Behavior of items under traffic

Item 1. Figure 4 shows item 1 prior to traffic. Mat breaks first became apparent at about 45 coverages; differential deformations developed slowly, averaging less than 1 in. for each of the three straightedge positions at 90 coverages. At 109 coverages, mat runs 16 through 19 at the transition between item 1 and the previously failed item 2 were removed for subgrade repairs. After repairs and replacement of mat panels, traffic was continued. The item was considered failed due to roughness at 199 coverages (figures 5 and 6). The rated CBR was 2.4.

Item 2. Figure 7 shows item 2 prior to traffic. By 20 coverages average differential deformations generally exceeded 1 in. on the item surface. It was observed during trafficking that at each pass of the load vehicle when the longitudinal mat-joint line was straddled by two load wheels, the overlapping ends of the planks at the joint would protrude upward. However, when a load wheel passed directly over the joint line, the plank ends were pressed flat again. Thus, the worst condition of mat roughness occurred when the former situation existed. The item was considered failed due to roughness at 102 coverages (figures 8 and 9). The rated CBR was 4.1.

Item 3. Figure 10 shows item 3 prior to traffic. The soil surface rutted easily and the item was considered failed due to rutting at 20 coverages (figure 11). The rated CBR was 9.8.

Test results

Results of trafficking lane 9 are summarized in table 1. Soil test data are presented in table 2. Table 1 contains drawbar pull values for the load vehicle operated over an asphalt-paved strip for comparison with drawbar pull values recorded on the test lane.

Item 1. Item 1 was considered failed due to roughness at 199 traffic coverages. The following information was obtained from traffic tests on item 1.

a. Roughness. Table 1 shows the steady increase in differential deformations with increased traffic coverages. At failure the average transverse, diagonal, and longitudinal differential deformations were 1.90, 1.80, and 1.23 in., respectively. Dishing, shown in table 1, averaged 0.54 in. at failure.

b. Deformation. Figures 23 and 24, respectively, show average cross-section and profile plots for 20 and 199 coverages. Cross-section measurements for both typical mat runs are shown in figure 23. The deformation plots illustrate the subsidence and troughing effect that existed at failure of the item.

c. Deflection. Average elastic mat deflections measured at 0, 20, and 199 coverages are shown in figure 25. Plots representing deflections measured with the wheel assembly at three positions relative to mat end joints are shown. Elastic soil deflection directly beneath a load wheel was 1.8 in. at failure.

d. Rolling resistance. Drawbar pull values for several coverage levels are presented in table 1. All drawbar pull values increased substantially with the number of traffic coverages.

e. Mat breaks. The number and types of mat breaks are shown in table 1 for failure and for several intermediate coverage levels. A relatively large number of minor mat breaks were observed, but no severe mat failures occurred.

f. Mat embedment. On removal of the mat from the subgrade at the conclusion of testing, it was observed that due to subsidence of the subgrade, the mat was not in full contact with the soil surface but was "bridging" in certain areas. The mat had been fully embedded at the start of testing, but the soil which had been extruded between the supporting tees beneath the mat had sheared and the mat was no longer embedded in the subgrade.

Item 2. Item 2 was considered failed due to roughness at 102 coverages. The following information was obtained from traffic tests on item 2.

a. Roughness. Differential deformations that developed with traffic are presented in table 1. Deformations increased consistently and averaged 1.48, 2.57, and 2.50 in., respectively, at failure for longitudinal, transverse, and diagonal directions. Dishing of individual mat panels averaged 0.45 in.

b. Deformation. Average cross-section plots at 20 and 102 coverages are shown in figure 23 for the two typical mat runs. At failure the center-line surface elevation was higher in both plots than prior to trafficking. A profile along the mat-joint line, 0.25 ft east of the lane center line, is shown in figure 24. The elevation of the mat ends caused when two wheels straddled the mat-joint line is evident at the 20- and 102-coverage levels represented.

c. Deflection. Average elastic mat deflections are represented in figure 25 for 0, 20, and 102 coverages. Deflections are plotted for the wheel assembly at three positions relative to mat end joints. Deflections plotted for 0 and 20 coverages were erratic.

Maximum deflections occurred at 102 coverages for all positions. Elastic soil deflections for 0, 20, and 102 coverages are shown in table 1, with a maximum of 1.1 in. recorded at 102 coverages.

d. Rolling resistance. Drawbar pull values for several coverage levels are shown in table 1. At failure all drawbar pull values showed an increase over the initial readings recorded prior to trafficking.

e. Mat breaks. Mat breaks observed during testing were classified by type and are shown in table 1. There were very few mat breaks at failure of the item.

Item 3. Item 3 was considered failed due to rutting at 20 coverages. The following information was obtained from traffic tests on item 3.

a. Roughness. Differential deformations and rut depths at 20 coverages are shown in table 1. At failure transverse and diagonal differential deformations averaged slightly over 3.5 in. and the average rut depth was 3.25 in.

b. Deformation. Average cross-section deformations at 20 coverages are shown in figure 23. The irregular appearance of the plot reflects the rutted condition of the surface. Profile deformations are shown in figure 24.

c. Deflection. Average total soil deflections measured at 0 and 20 coverages are shown in figure 25. Large deflections were recorded at failure. Elastic soil deflections, shown in table 1, were 0.3 and 0.8 in. at 0 and 20 coverages, respectively.

d. Rolling resistance. Drawbar pull values are presented in table 1. Initial and peak drawbar values show large increases at 20 coverages. Rolling drawbar pull values increased less significantly.

Lane 10

Behavior of items under traffic

Item 1. Figure 12 shows item 1 prior to traffic. During early trafficking of the item, mat breaks began to develop and differential deformation averaged slightly greater than 1 in. at 19 traffic coverages. The item was considered failed due to roughness at 74 coverages (figures 13 and 14). The rated CBR of the item was 2.6.

Item 2. Figure 15 shows item 2 prior to traffic. Upward displacement of the panel ends at the mat joints was the principal sign of deterioration during trafficking of the item. The item was considered

failed due to roughness at 48 coverages due primarily to displacement at the end joints (figures 16 and 17). The rated CBR was 4.0.

Item 3. Figure 18 shows item 3 prior to traffic. The surface deformed easily under traffic and the item was considered failed due to rutting at 24 coverages (figure 19). The rated CBR of the item was 9.8.

Test results

Traffic data recorded on lane 10 are summarized in table 1. Soil test data are given in table 2. Table 1 shows drawbar pull values for the load vehicle operated over an asphalt-paved strip for comparison with drawbar pull values recorded on the test lane.

Item 1. Item 1 was considered failed due to roughness at 74 coverages. The following information was obtained from traffic tests on item 1.

a. Roughness. Differential deformations for numerous coverage levels are shown in table 1. At failure, the average transverse, diagonal, and longitudinal differential deformations were 2.65, 2.55, and 1.50 in., respectively. Dishing of individual panels averaged 0.63 in.

b. Deformation. For each of the two typical mat runs, figure 23 shows average cross-section deformations at 19 and 74 coverages. Shown in figure 24 is a profile along the lane center line representing the same coverage levels.

c. Deflection. Average elastic mat deflections under static load of the load-wheel assembly for three positions of the assembly relative to mat end joints are plotted in figure 25. Deflection measurements at 0, 19, and 74 coverages are shown. In each plot the deflection curve assumed a shape similar to that of a single-wheel assembly. Elastic soil deflection at failure was 1.7 in.

d. Rolling resistance. Drawbar pull values record[illegible]ntervals during the test period are given in table 1. I[illegible] peak, and rolling drawbar pull values increased with traff[illegible] to the 48-coverage level but showed a decrease when measured at 74 coverages. Initial and rolling drawbar pull values were less at failure than prior to traffic.

e. Mat breaks. The number of mat breaks are shown by type in table 1 for several coverage levels. A relatively large number of breaks occurred during trafficking.

Item 2. Item 2 was considered failed due to roughness at 48 coverages. The following information was obtained from traffic tests on item 2.

a. Roughness. Table 1 lists differential deformations recorded at intervals during testing. A consistent increase in differential deformation occurred throughout trafficking. At failure, average transverse, diagonal, and longitudinal differential deformations were 2.85, 2.81, and 2.38 in., respectively. Average dishing of individual panels was 0.53 in.

b. Deformation. Average cross-section deformations at 19 and 48 coverages for each of the two typical mat runs are plotted in figure 23. Figure 24 shows a center-line profile representing the same coverage levels. The cross-section plots emphasize the characteristic high point that developed at the mat end joints located within the traffic lane.

c. Deflection. Average elastic mat deflections under static load of the load-wheel assembly are plotted in figure 25 for three positions of the assembly relative to mat end joints. Measurements made for 0, 19, and 48 coverages are represented. Elastic soil deflections (maximum of 2.3 in. at 48 coverages) are shown in table 1.

d. Rolling resistance. Drawbar pull values are shown in table 1 for several coverage levels. Peak and rolling drawbar values increased consistently with increased coverages while initial drawbar pull values were relatively unchanged with trafficking.

e. Mat breaks. Although the mat was severely deformed at failure, no breaks occurred.

Item 3. Item 3 was considered failed due to rutting at 24 coverages. The following information was obtained from traffic tests on item 3.

a. Roughness. Table 1 shows differential deformations and rut depths measured at 19 and 24 coverages. The transverse and diagonal differential deformations averaged 3.90 and 4.17 in., respectively, at failure. Rut depths at failure averaged 3.90 in.

b. Deformation. Average cross-section deformations at 24 coverages are represented in figure 23. Center-line profile deformations are plotted in figure 24. The absence of severe longitudinal deformations allows a relatively smooth profile curve which illustrates the general subsidence along the traffic lane.

c. Deflection. Average total soil deflections measured at 0 and 24 coverages are plotted in figure 25. A large increase in total deflection occurred with trafficking. Elastic deflections, shown in table 1, decreased slightly with trafficking, measuring 0.4 and 0.2 in. at 0 and 24 coverages, respectively.

d. <u>Rolling resistance.</u> Drawbar pull values recorded at 0 and 24 coverages are shown in table 1. Small increases were measured at 24 coverages for peak and rolling drawbar pull. A 4.0-kip decrease occurred in the initial drawbar pull values.

SECTION V: PRINCIPAL FINDINGS

From the foregoing discussion, the principal findings relating test load, wheel assembly, tire inflation pressure, surface type, subgrade CBR, and traffic coverages are as follows:

Load, Wheel Assembly, and Tire Pressure	Type of Surface	Rated Subgrade CBR	Coverages at Failure
140,000-lb load; twin-twin wheel assembly (37-68-37 in. c-c); 56x16, 24-ply tires at 100-psi inflation pressure	Modified T11 aluminum mat	2.4	199
	M8 steel mat	4.1	102
	Unsurfaced	9.8	20
140,000-lb load; twin-tandem wheel assembly (37-in. c-c twin, 60-in. c-c tandem); 56x16, 24-ply tires at 100-psi inflation pressure	Modified T11 aluminum mat	2.6	74
	M8 steel mat	4.0	48
	Unsurfaced	9.8	24

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TABLE 1

SUMMARY OF TRAFFIC DATA, TEST SECTION 5

Test Item	Coverages	Rated CBR	No. of Mat Breaks* A	B	C	D	E	Differential Deformation (in.) Longitudinal Max	Longitudinal Avg	Transverse Max	Transverse Avg	Diagonal Max	Diagonal Avg	Dishing or Rutting (in.) Max	Avg	Drawbar Pull (kips) Initial	Peak	Rolling	Average Total Deflection (in.) with Center Line of Assembly Located on: Unsurfaced Item Max	Unsurfaced Item Center Line of Assembly	Quarter Point of Panel Max	Quarter Point of Panel Center Line of Assembly	Half Point of Panel Max	Half Point of Panel Center Line of Assembly	Joint of Panel Max	Joint of Panel Center Line of Assembly	Elastic Subgrade Deflection (in.)	Remarks
Lane 9																												
1	0		--	--	--	--	--	--	--	--	--	--	--	--	--	17.2	12.6	10.2	--	--	3.0	1.7	2.7	1.7	2.8	1.5	--	Failed at 199 coverages due to roughness
Modified T11	20		--	--	--	--	--	0.63	0.53	0.25	0.22	0.50	0.41	0.25	0.25	--	16.4	13.5	--	--	3.8	2.6	3.0	1.9	4.0	2.4	--	
aluminum	45		3	7	--	3	--	1.13	0.78	0.75	0.59	0.88	0.72	0.38	0.28	--	--	--	--	--	--	--	--	--	--	--	--	
landing mat	68		16	18	--	5	--	1.13	0.79	1.00	0.81	1.25	0.94	0.38	0.32	--	--	--	--	--	--	--	--	--	--	--	--	
	90	2.4	19	45	--	19	--	1.00	0.93	1.00	0.90	1.00	0.90	0.38	0.31	--	--	--	--	--	--	--	--	--	--	--	--	
	136		28	151	18	49	--	1.75	1.09	1.50	1.19	2.00	1.46	0.50	0.45	--	--	--	--	--	--	--	--	--	--	--	--	
	181		30	158	64	64	2	1.75	1.21	2.00	1.75	2.25	1.62	0.63	0.53	--	--	--	--	--	--	--	--	--	--	--	--	
	199		38	197	93	75	2	1.75	1.23	2.25	1.90	2.25	1.80	0.63	0.54	22.3	24.2	16.2	--	--	5.2	3.0	4.5	2.6	3.8	1.8	1.8	
2	0		--	--	--	--	--	--	--	--	--	--	--	--	--	15.3	13.5	8.4	--	--	2.0	0.6	1.9	0.7	1.9	0.1	1.0	Failed at 102 coverages due to roughness
M8 steel	20		--	--	--	--	--	1.13	1.00	1.13	0.95	1.25	1.13	0.25	0.25	--	13.2	8.0	--	--	2.2	0.6	1.7	0.7	1.7	0.3	0.7	
landing mat	45	4.1	--	--	--	--	--	1.38	1.22	1.75	1.53	1.88	1.33	0.25	0.25	--	--	--	--	--	--	--	--	--	--	--	--	
	68		--	--	--	--	--	1.50	1.38	2.63	2.04	2.25	1.82	0.38	0.28	--	--	--	--	--	--	--	--	--	--	--	--	
	90		--	1	--	1	--	1.75	1.48	3.25	2.30	2.25	1.88	0.38	0.33	--	--	--	--	--	--	--	--	--	--	--	--	
	102		4	1	--	2	--	1.63	1.48	4.13	2.57	3.38	2.50	0.50	0.45	17.3	14.0	9.9	--	--	2.9	0.4	2.1	1.3	2.4	0.7	1.1	
3	0	9.8	--	--	--	--	--	--	--	--	--	--	--	--	--	15.3	19.1	10.3	1.1	--	--	--	--	--	--	--	0.3	Failed at 20 coverages due to rutting
Unsurfaced	20		--	--	--	--	--	1.00	0.78	4.00	3.69	4.25	3.56	3.50	3.25	25.7	24.4	11.6	3.2	--	--	--	--	--	--	--	0.8	
Asphalt strip	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.9	5.4	3.7	--	--	--	--	--	--	--	--	--	
Lane 10																												
1	0		--	--	--	--	--	--	--	--	--	--	--	--	--	15.8	11.7	9.9	--	--	2.8	2.8	2.2	2.2	2.3	2.3	--	Failed at 74 coverages due to roughness
Modified T11	19		1	12	--	29	--	1.25	1.09	1.25	1.10	1.13	1.13	0.75	0.56	--	--	--	--	--	3.8	3.8	2.9	2.9	3.3	3.9	--	
aluminum	24	2.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.2	10.8	--	--	--	--	--	--	--	--	--	
landing mat	43		5	54	2	36	--	1.63	1.41	2.25	1.88	2.13	1.72	0.63	0.53	--	--	--	--	--	--	--	--	--	--	--	--	
	48		6	59	3	48	2	1.50	1.35	1.75	1.56	1.75	1.60	0.50	0.50	16.7	14.1	12.0	--	--	--	--	--	--	--	--	--	
	74		10	87	54	86	2	1.75	1.50	3.00	2.65	2.75	2.55	0.75	0.63	13.4	13.5	9.5	--	--	4.5	4.5	3.1	3.1	5.8	5.8	[illegible]	
2	0		--	--	--	--	--	--	--	--	--	--	--	--	--	15.0	[illegible]	6.9	--	--	2.0	1.8	1.7	1.4	1.6	0.8	0.9	Failed at 48 coverages due to roughness
M8 steel	19		--	--	--	--	--	1.13	0.95	1.63	1.42	1.50	1.41	0.38	0.31	--	--	--	--	--	2.5	2.1	2.7	2.7	2.4	2.4	1.6	
landing mat	24	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0	8.0	--	--	--	--	--	--	--	--	--	
	43		--	--	--	--	--	2.13	1.82	2.63	2.54	2.50	2.35	0.63	0.53	--	--	--	--	--	--	--	--	--	--	--	--	
	48		--	--	--	--	--	2.50	2.38	3.50	2.85	3.25	2.81	0.63	0.53	14.9	10.3	8.8	--	--	2.3	2.1	3.0	2.3	3.0	2.8	[illegible]	
3	0		--	--	--	--	--	--	--	--	--	--	--	--	--	15.8	9.4	7.4	1.2	0.4	--	--	--	--	--	--	0.4	Failed at 24 coverages due to rutting
Unsurfaced	19	9.8	--	--	--	--	--	0.38	0.31	4.00	2.80	3.88	2.56	3.50	2.71	--	--	--	--	--	--	--	--	--	--	--	--	
	24		--	--	--	--	--	0.50	0.35	5.13	3.90	5.00	4.17	4.50	3.90	11.8	11.7	9.1	2.1	0.3	--	--	--	--	--	--	0.2	
Asphalt strip	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.7	3.5	2.3	--	--	--	--	--	--	--	--	--	

Note: For lane 9, a twin-twin assembly (37-68-37 in. c-c and loaded to 140,000 lb) with 56x16, 24-ply tires inflated to 100 psi was used for trafficking. For lane 10, a twin-tandem assembly (37-in. c-c twin, 60-in. c-c tandem assembly loaded to 140,000 lb) with 56x16, 24-ply tires inflated to 100 psi was used for trafficking.

* Break types are defined and illustrated in Part I.

TABLE 2

SUMMARY OF CBR, DENSITY, AND WATER CONTENT DATA, TEST SECTION 5

Test Item*	Type of Surface	Coverages	Depth (in.)	CBR	Water Content (%)	Dry Density (lb/cu ft)	Remarks
			Lane 9				
1	Modified T11 aluminum landing mat	0	0	2.5	28.7	88.7	Item failed at 199 coverages due to roughness
			6	2.0	28.3	89.4	
			12	2.5	27.7	91.2	
			18	3.4	26.7	92.7	
		199	0	2.0	29.4	90.4	
			6	2.6	30.1	90.2	
			12	2.7	29.3	89.7	
			18	1.1	31.6	88.0	
2	M8 Steel landing mat	0	0	4.0	25.9	93.3	Item failed at 102 coverages due to roughness
			6	3.8	25.5	93.1	
			12	3.2	28.4	90.0	
			18	3.2	27.6	92.2	
		102	0	6.2	24.8	96.6	
			6	4.0	27.2	92.6	
			12	3.2	27.2	92.4	
			18	6.2	29.2	91.3	
3	Unsurfaced	0	0	8.0	25.2	95.4	Item failed at 20 coverages due to rutting
			6	10.0	25.6	94.8	
			12	11.0	24.1	91.5	
			18	12.0	22.9	93.7	
		20	0	8.0	25.6	96.5	
			6	9.0	24.8	97.1	
			12	13.0	23.6	95.7	
			18	9.0	24.2	96.6	
			Lane 10				
1	Modified T11 aluminum landing mat	0	0	2.5	31.7	85.5	Item failed at 74 coverages due to roughness
			6	No representative data			
			12	2.3	30.4	88.3	
			18	2.1	32.6	85.7	
		74	0	3.5	31.6	87.4	
			6	2.6	30.5	88.0	
			12	2.2	30.6	88.3	
			18	2.7	29.7	88.0	
2	M8 Steel landing mat	0	0	4.6	27.1	92.3	Item failed at 48 coverages due to roughness
			6	4.4	26.9	92.3	
			12	4.0	29.4	89.6	
			18	4.5	27.6	91.9	
		48	0	5.0	26.7	93.0	
			6	2.7	26.6	92.4	
			12	3.3	26.9	92.4	
			18	4.4	25.3	94.4	
3	Unsurfaced	0	0	9.0	23.9	96.7	Item failed at 24 coverages due to rutting
			6	11.0	24.3	95.9	
			12	11.0	22.5	91.9	
			18	11.0	22.3	95.6	
		24	0	7.0	24.2	97.8	
			6	8.0	23.5	99.1	
			12	13.0	24.3	96.8	
			18	11.0	24.4	96.4	

* Subgrade material was a heavy clay (buckshot; classified as CH) in all items.

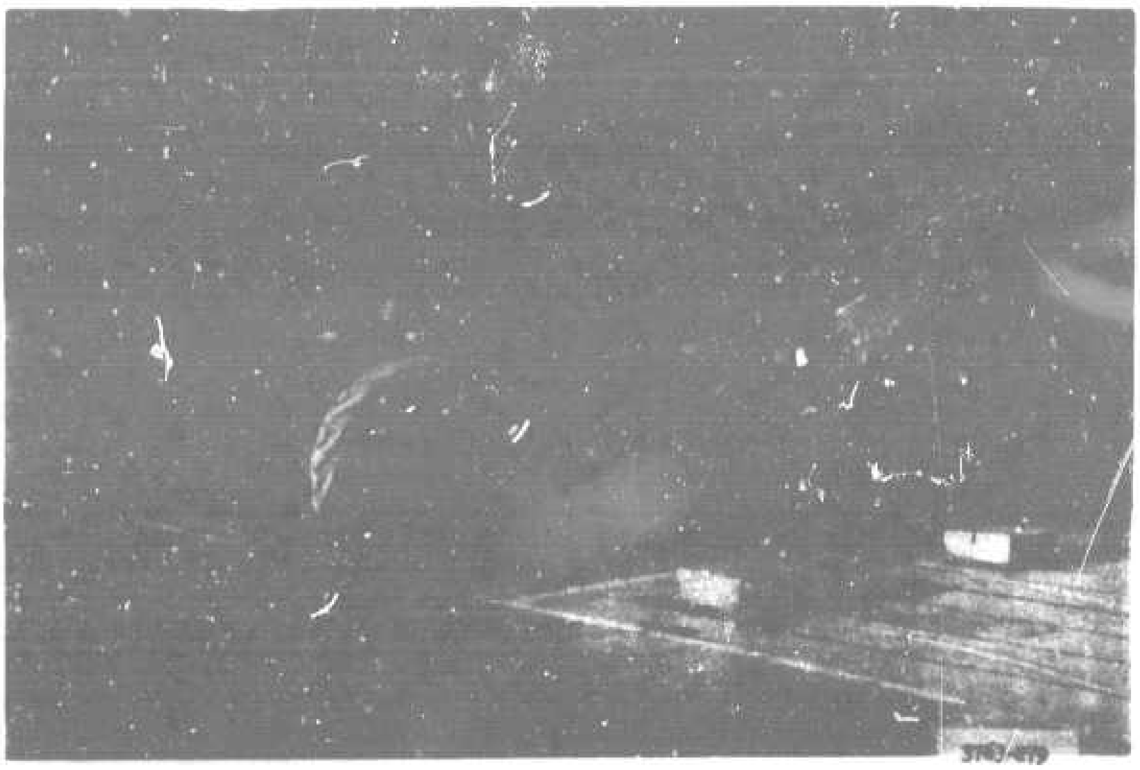


Figure 2. Test load vehicle used on lane 9

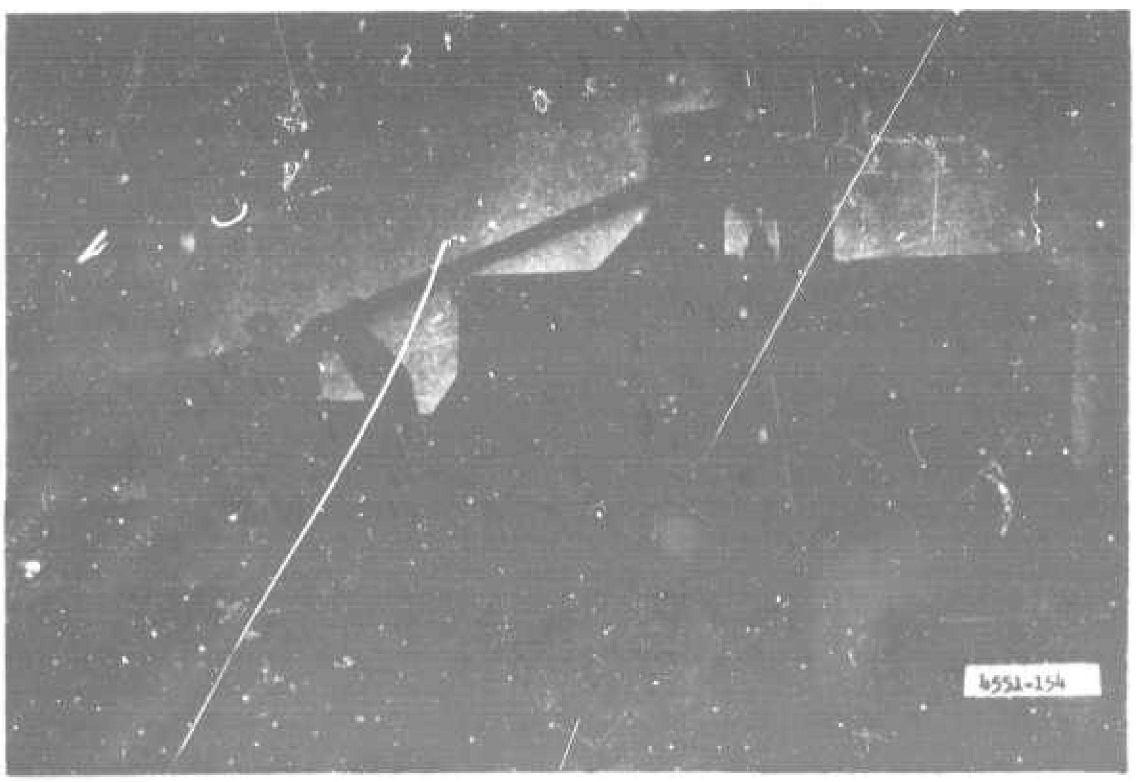


Figure 3. Test load vehicle used on lane 10

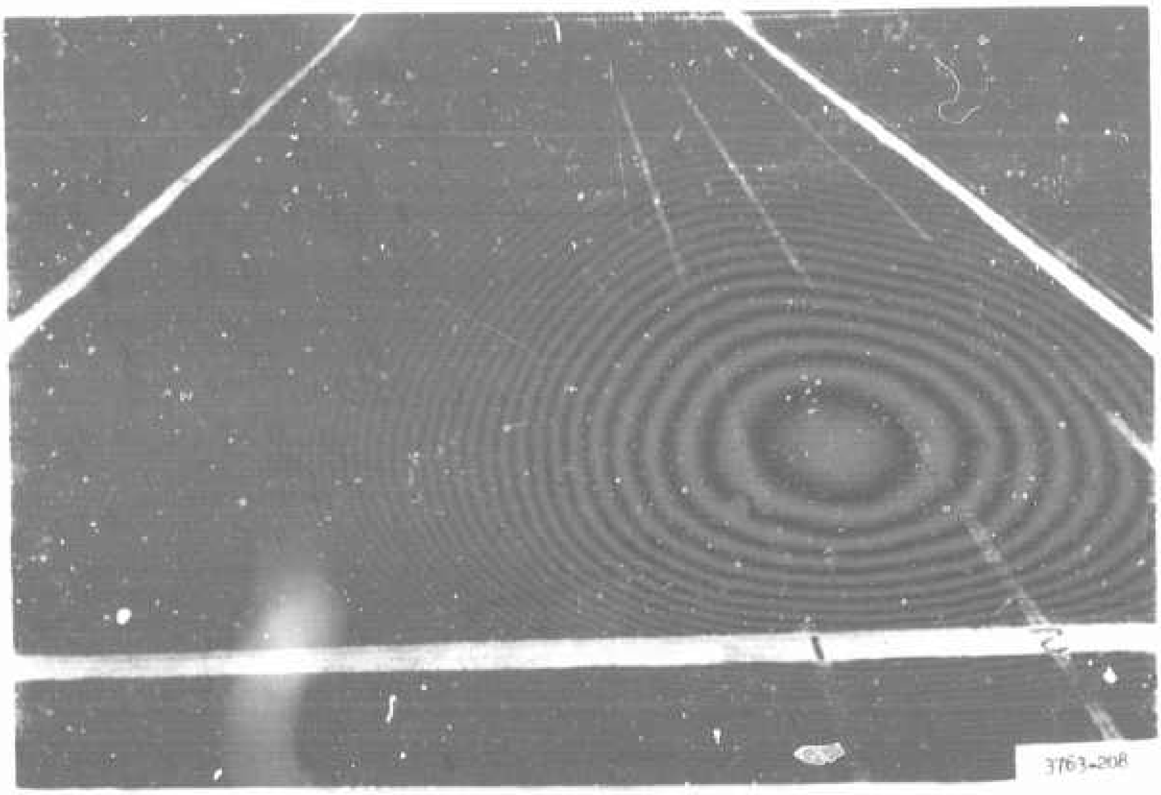


Figure 4. Lane 9, item 1, prior to traffic

Figure 5. Lane 9, item 1; general view at 199 coverages (failure

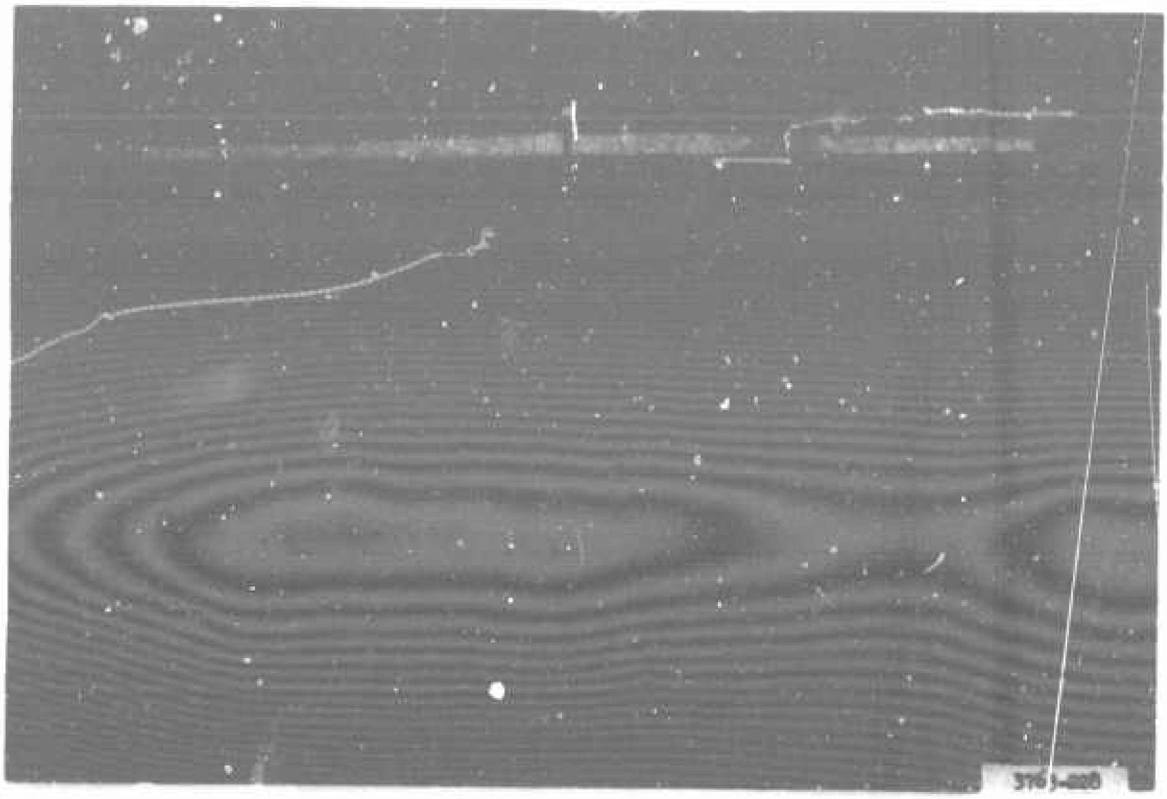


Figure 6. Lane 9, item 1. Diagonal straightedge shows roughness at 199 coverages (failure)

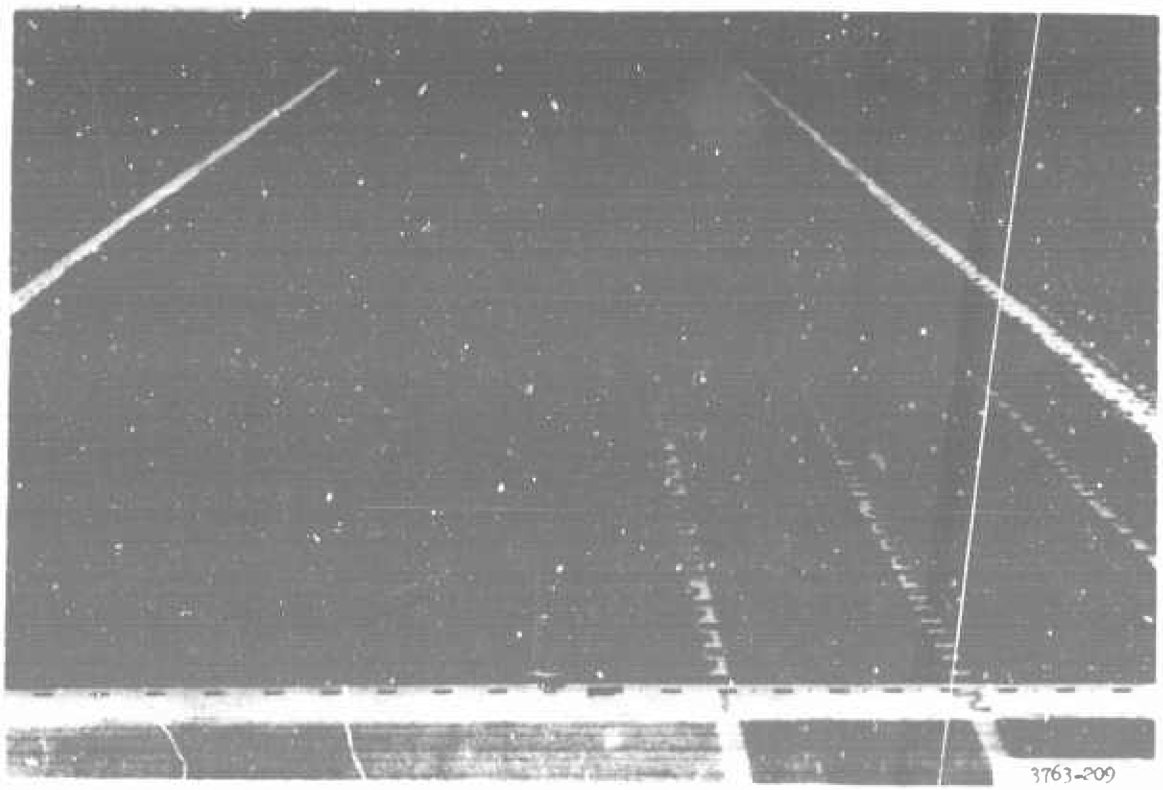


Figure 7. Lane 9, item 2, prior to traffic

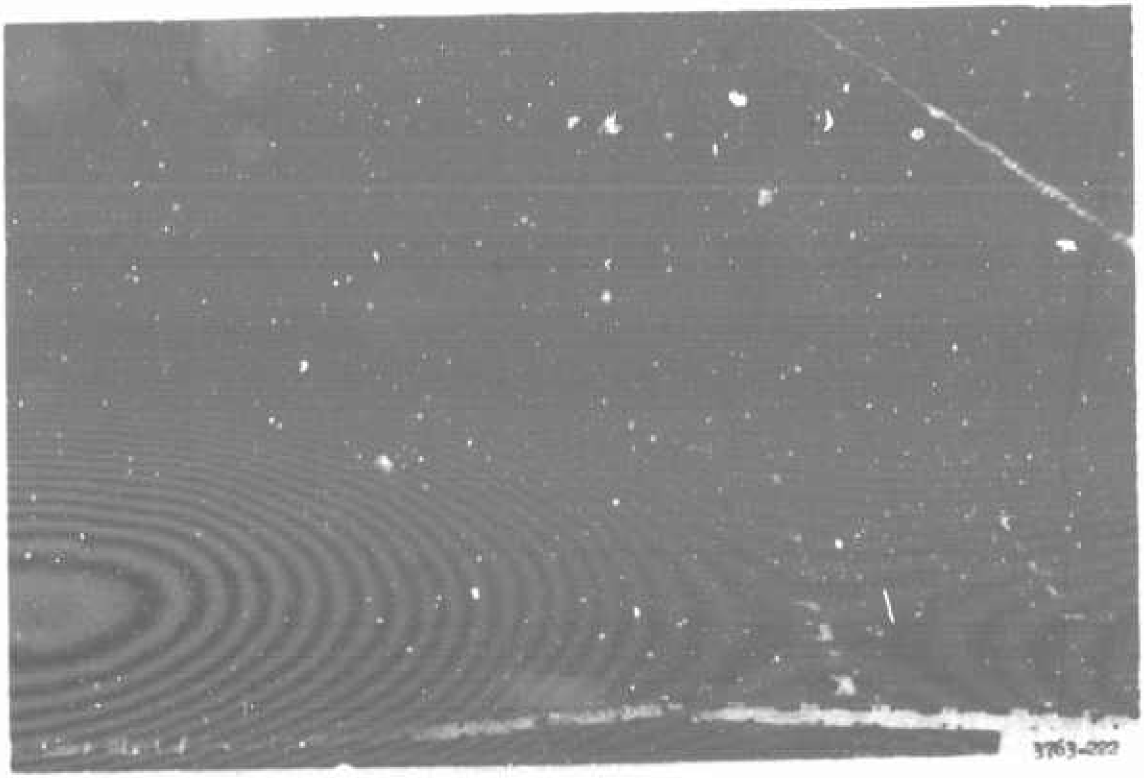


Figure 8. Lane 9, item 2; general view at 102 coverages (failure)

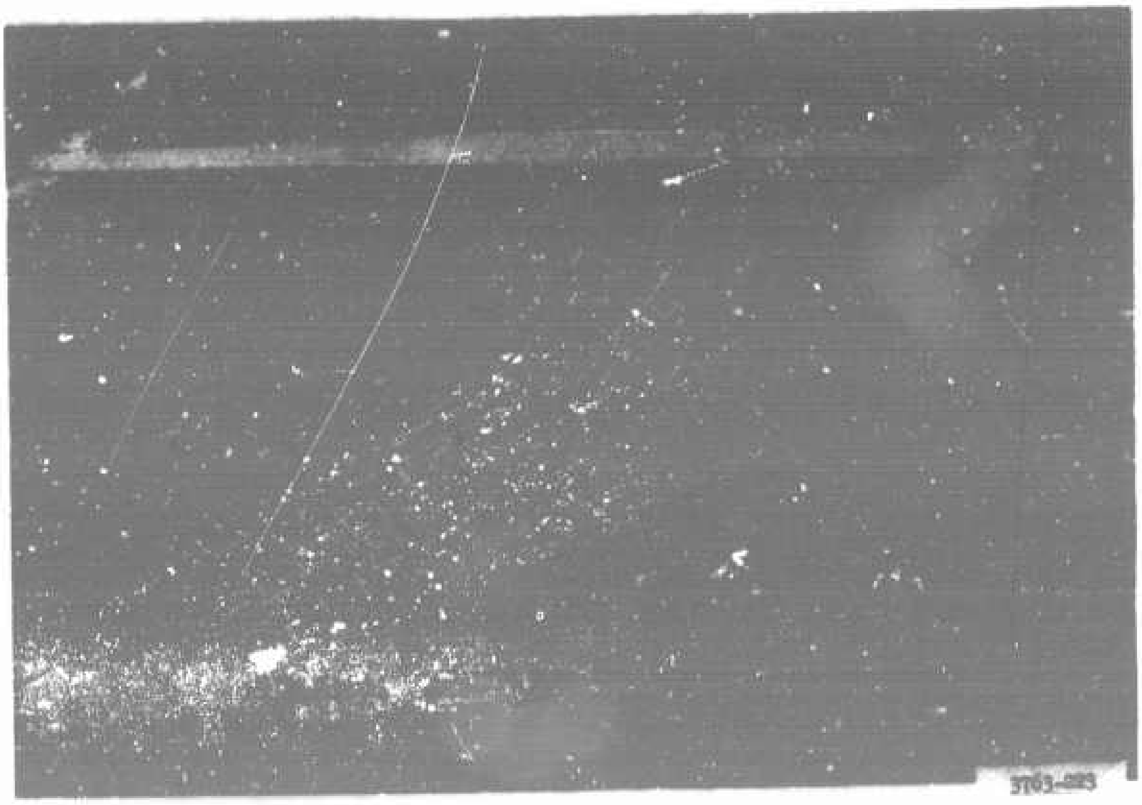


Figure 9. Lane 9, item 2. Transverse straightedge shows roughness at 102 coverages (failure)

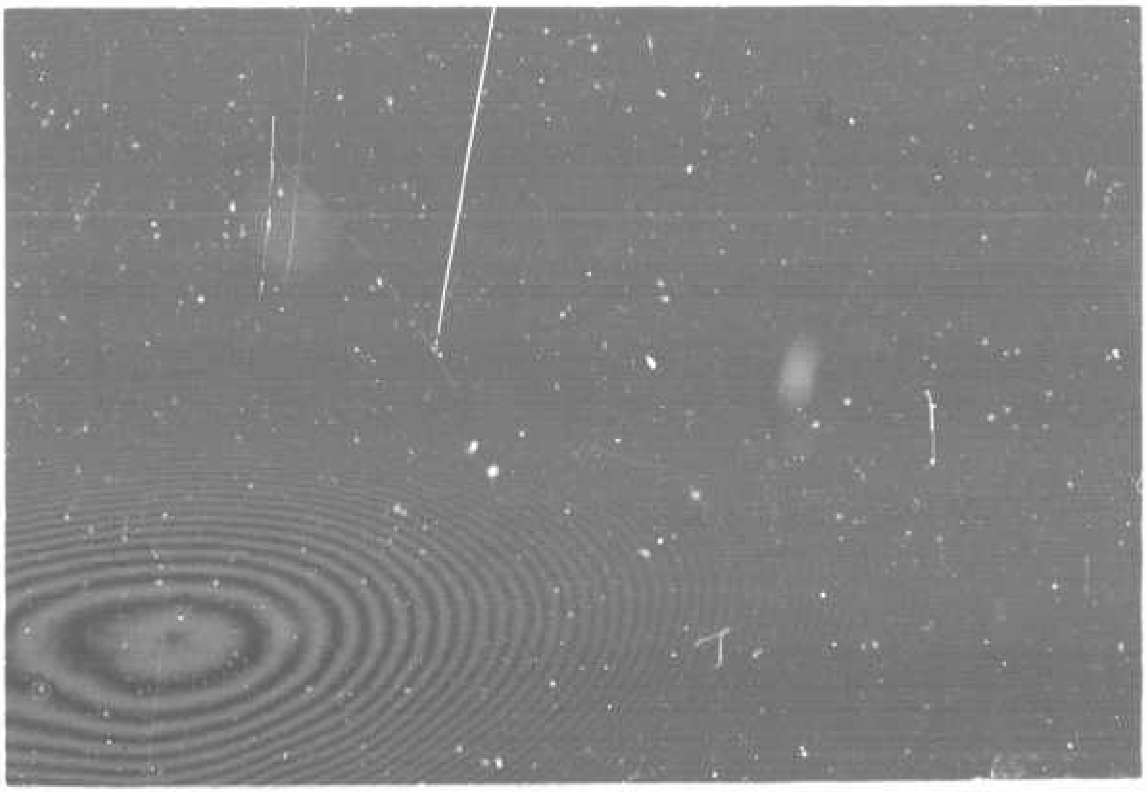


Figure 10. Lane 9, item 3, prior to traffic

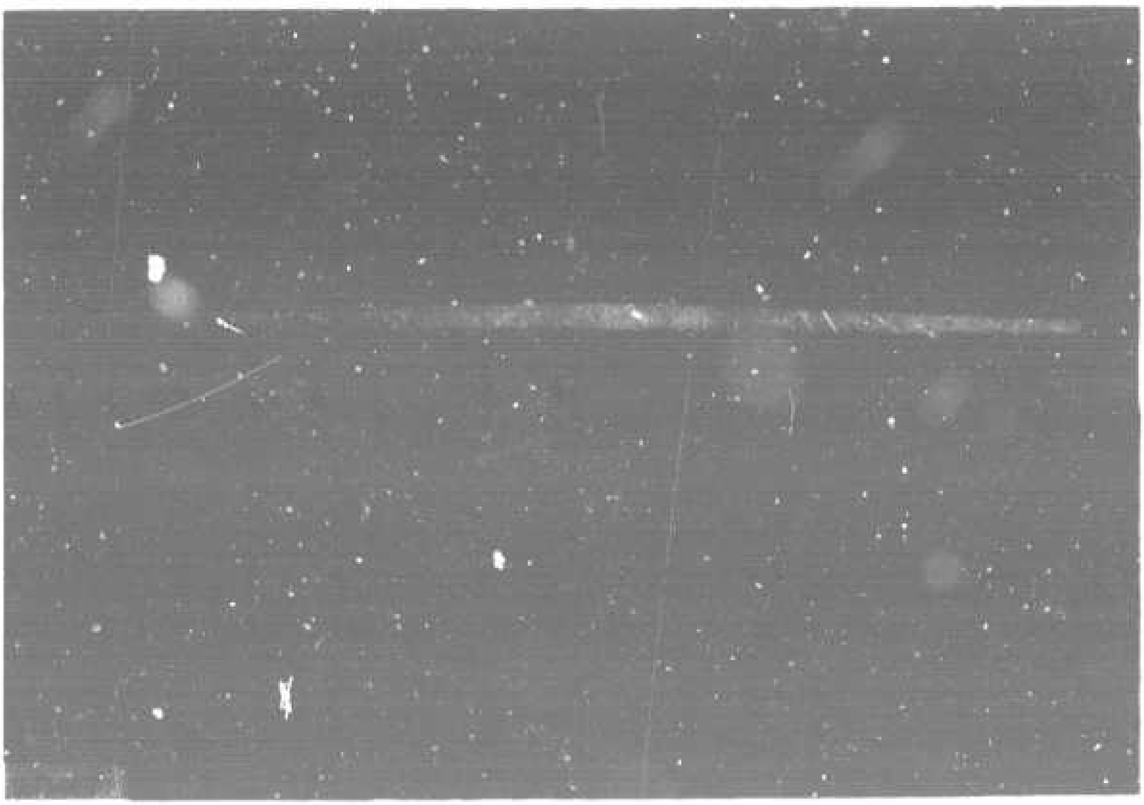


Figure 11. Lane 9, item 3. Transverse straightedge shows roughness at 20 coverages (failure)

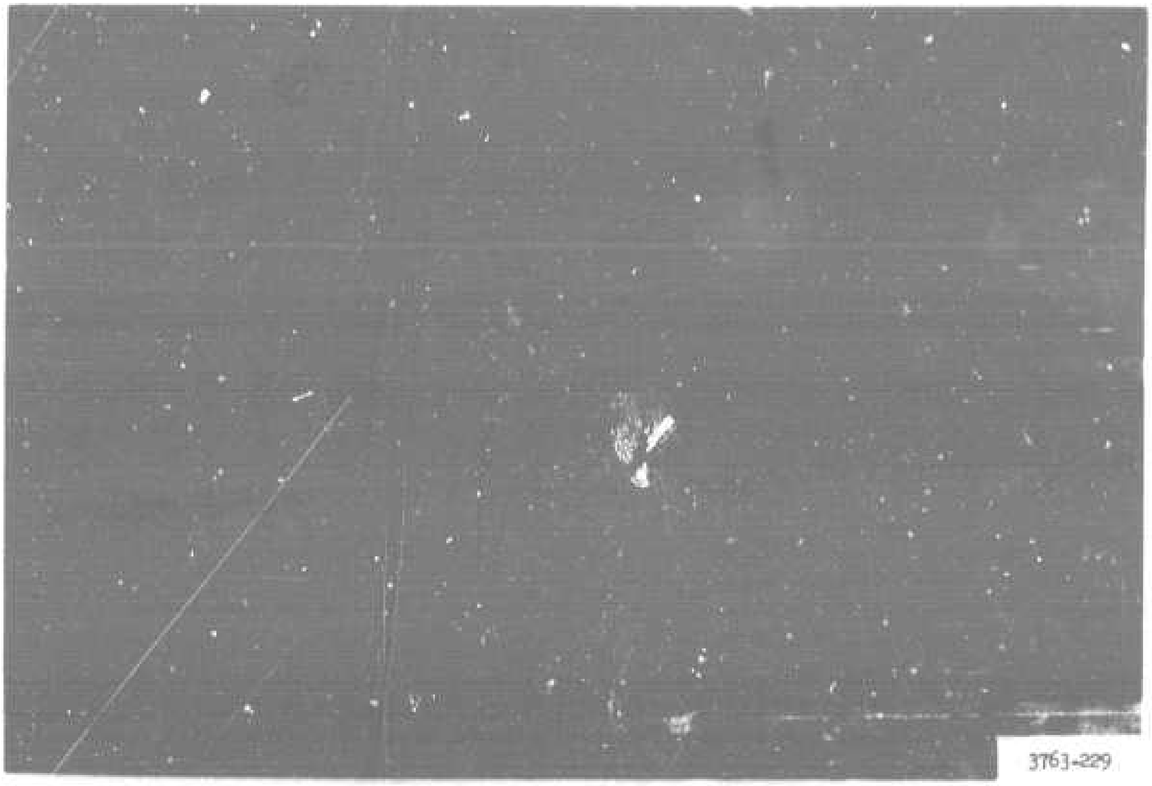


Figure 12. Lane 10, item 1, prior to traffic

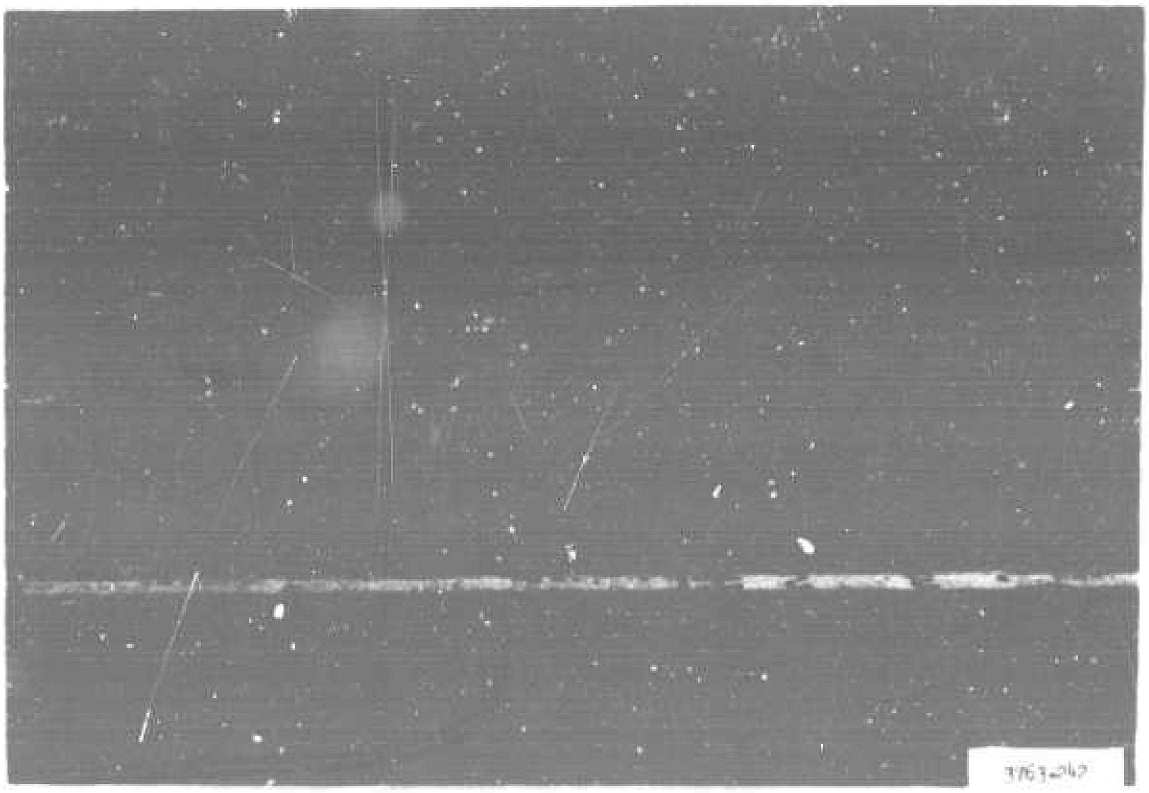


Figure 13. Lane 10, item 1; general view at 74 coverages (failure)

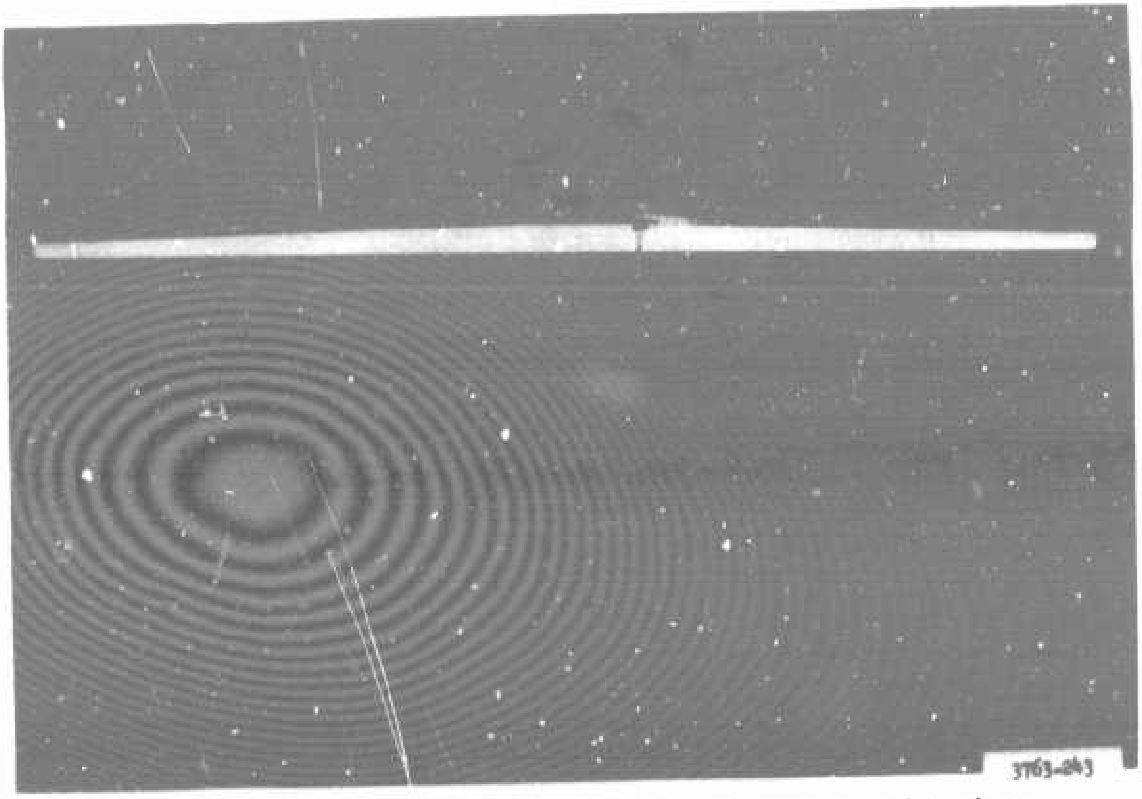


Figure 14. Lane 10, item 1. Transverse straightedge shows roughness at 74 coverages (failure)

Figure 15. Lane 10, item 2, prior to traffic

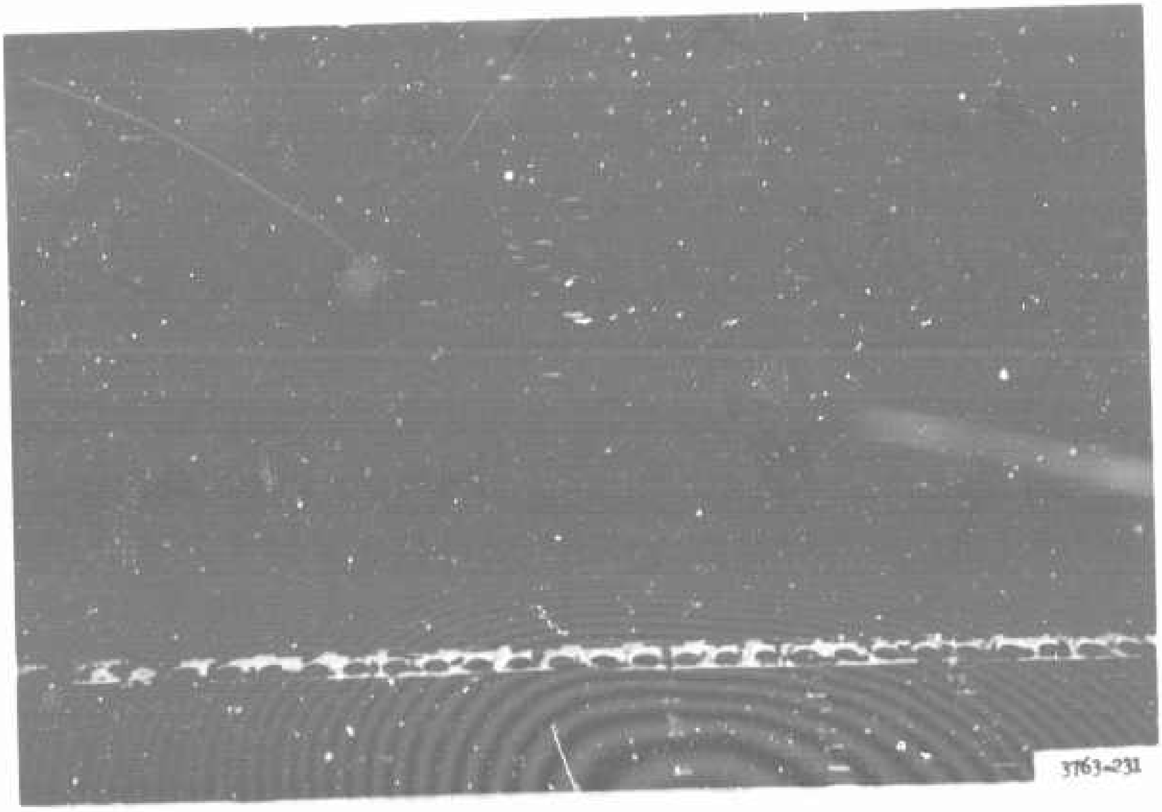


Figure 16. Lane 10, item 2; general view at 48 coverages (failure)

Figure 17. Lane 10, item 2. Diagonal straightedge shows roughness at 48 coverages (failure)

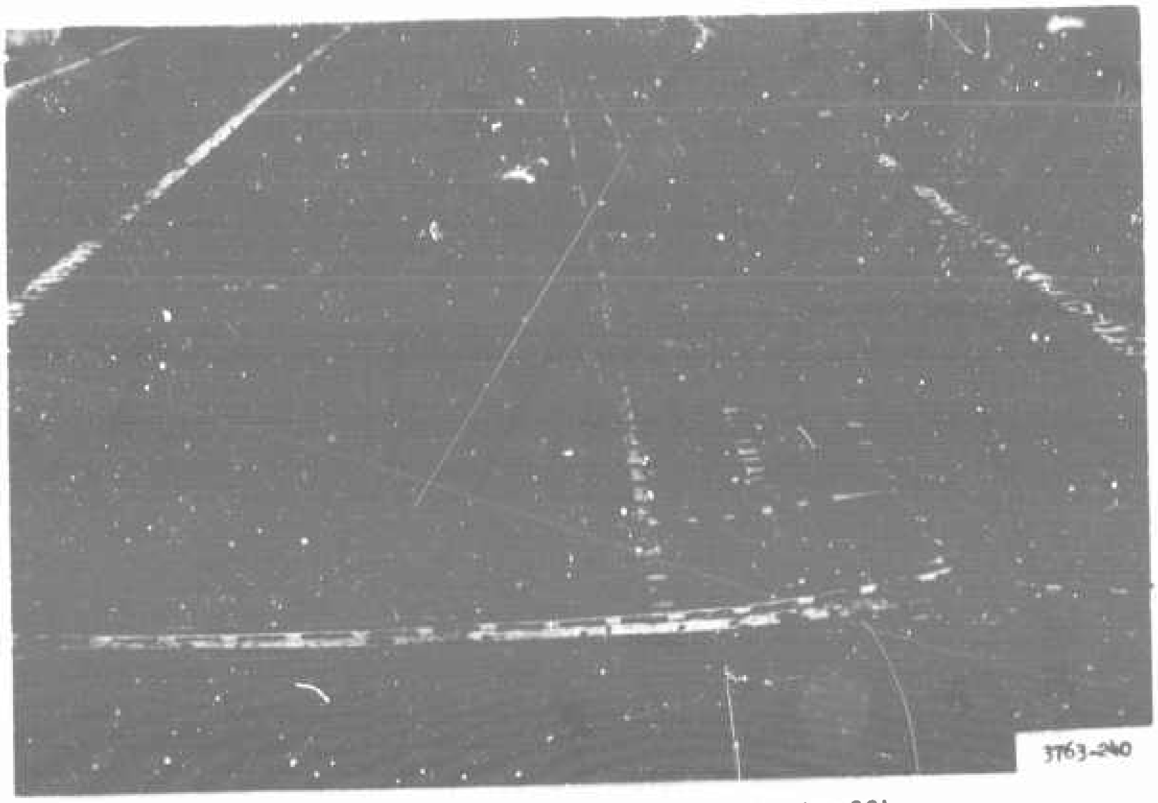


Figure 18. Lane 10, item 3, prior to traffic

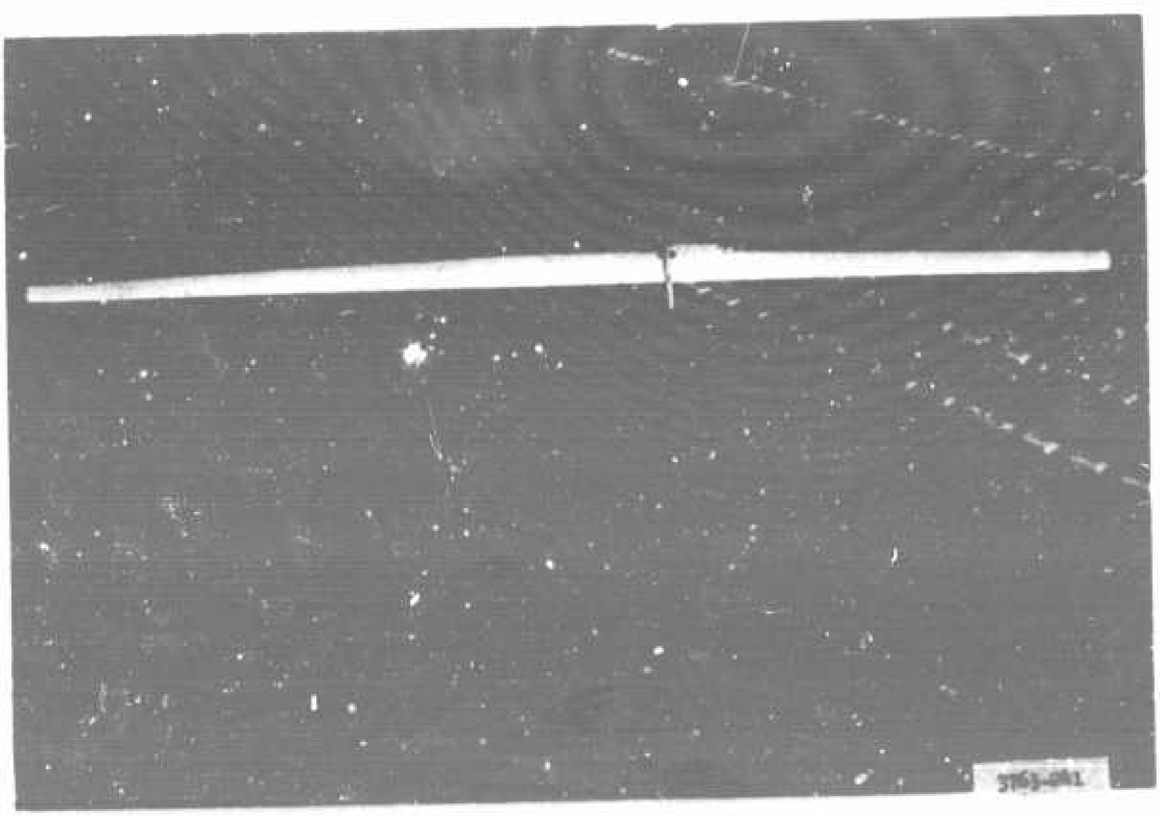
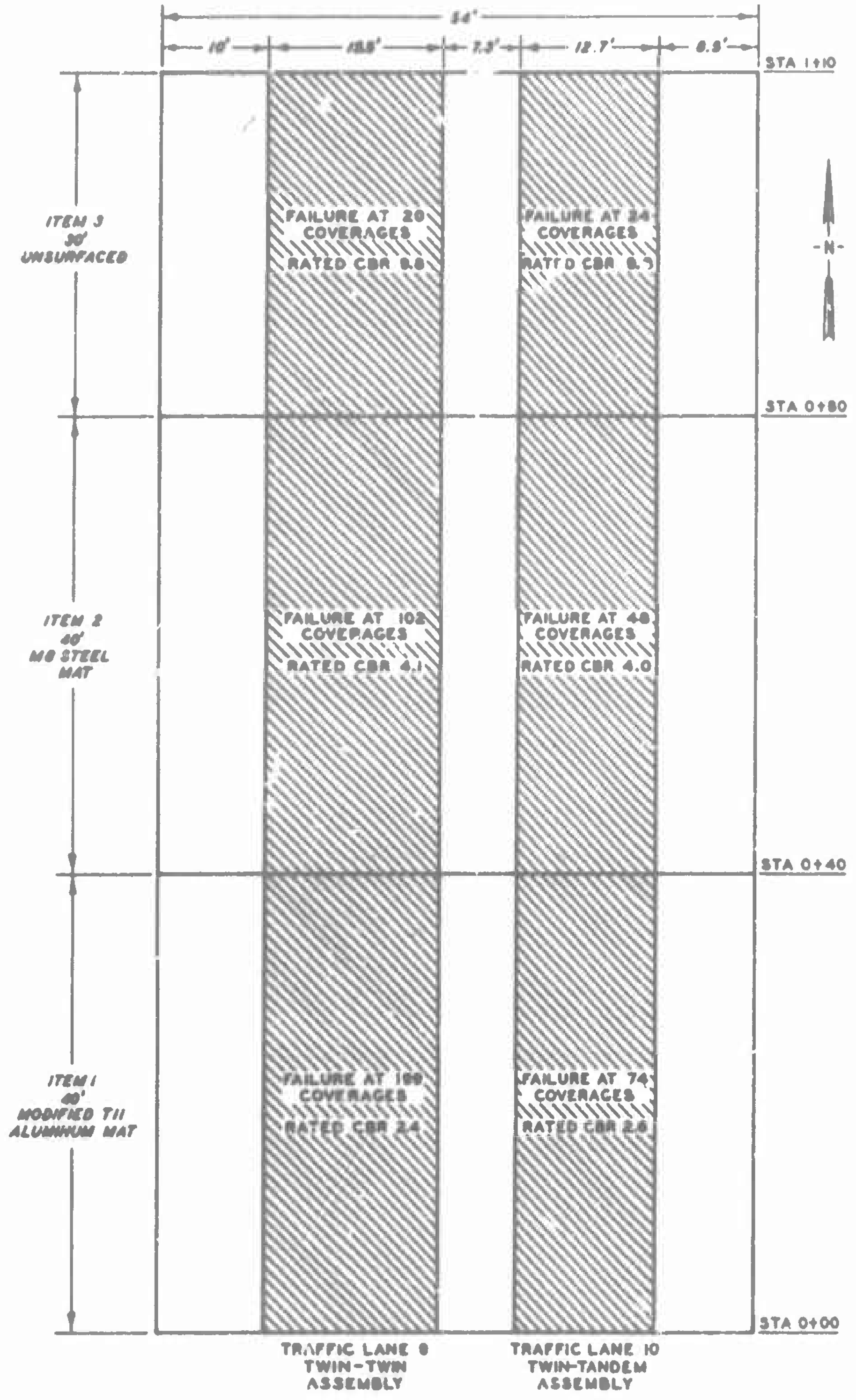


Figure 19. Lane 10, item 3. Transverse straightedge shows roughness at 24 coverages (failure)

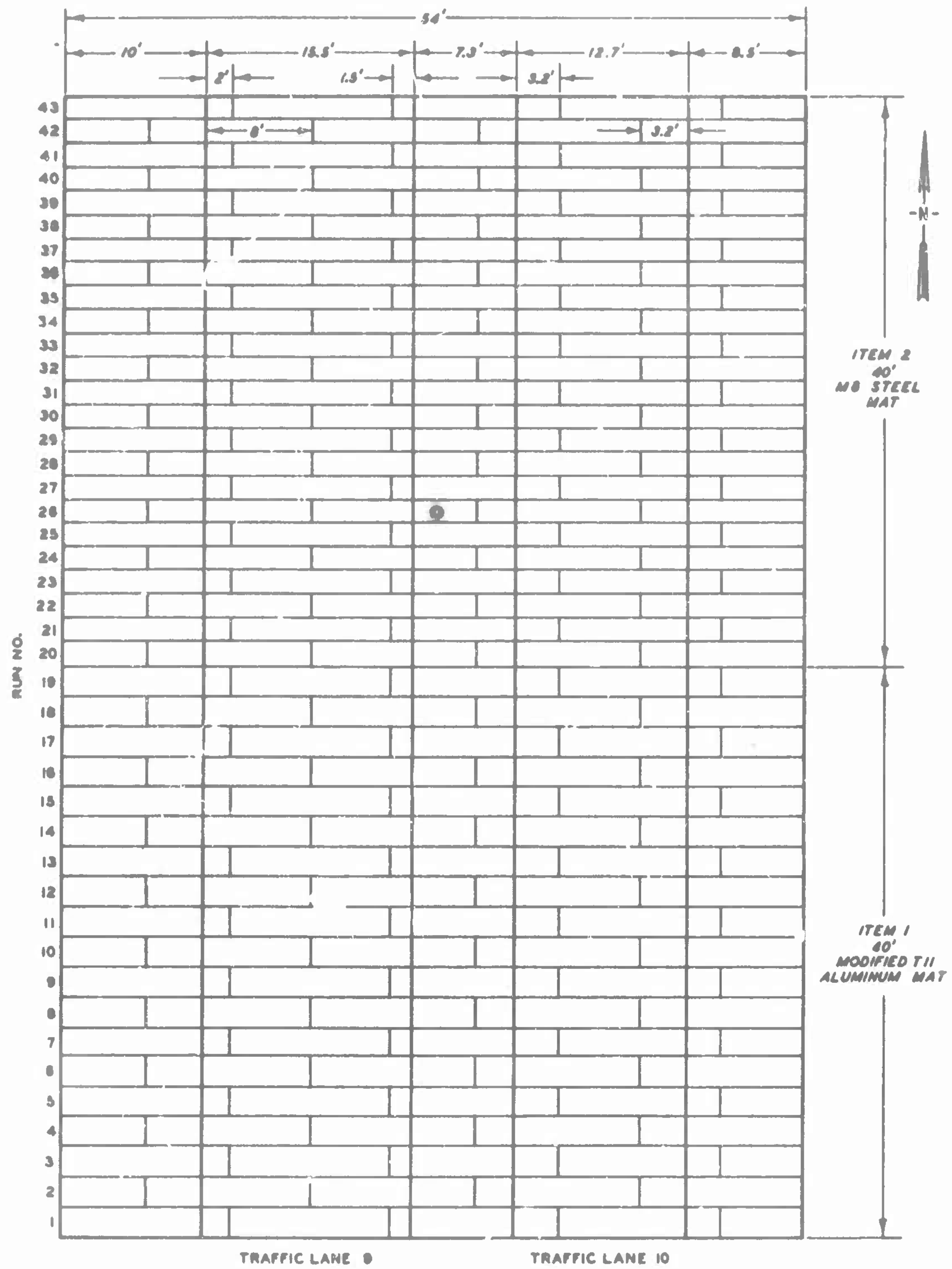


LAYOUT OF TEST SECTION 5
AND SUMMARY OF
TEST RESULTS

140-KIP LOAD

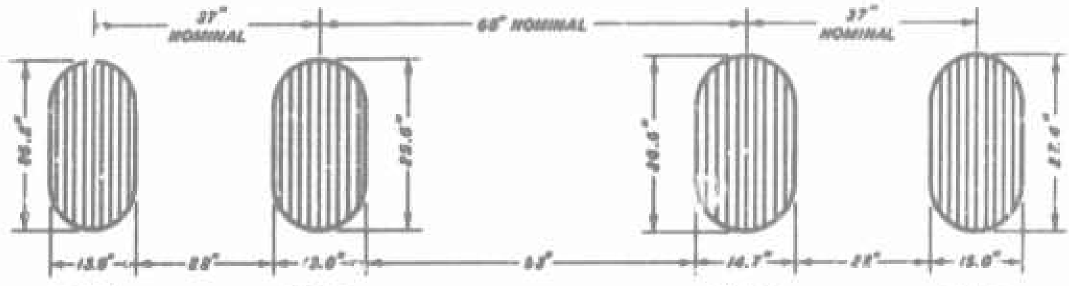
56X16, 24-PLY TIRES
100-PSI INFLATION PRESSURE

Figure 20



LAYOUT OF
SURFACED ITEMS
TEST SECTION 5
LANES 9 AND 10

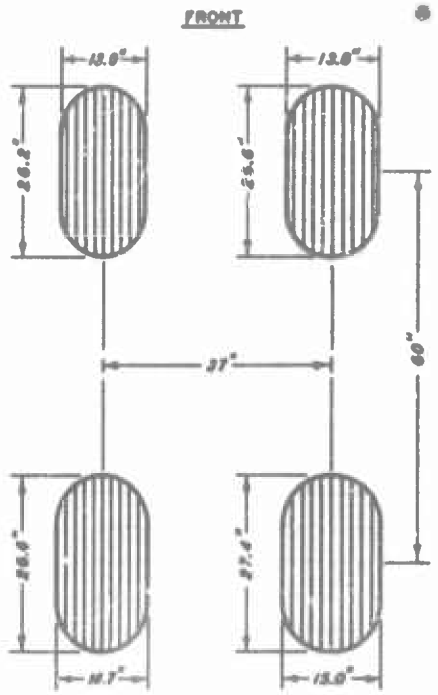
Figure 21



	TIRE 1	TIRE 2	TIRE 3	TIRE 4
TIRE SIZE	56X16	56X16	56X16	56X16
NO. OF PLYS	24	24	24	24
CONTACT AREA, SQ IN.	309	306	341	314
CONTACT PRESSURE, PSI	113	114	103	112
INFLATION PRESSURE, PSI	100	100	100	100
DEFLECTION, %	38.9	38.1	42.6	40.9

LANE 9

TWIN-TWIN ASSEMBLY



	LEFT FRONT	RIGHT FRONT	LEFT REAR	RIGHT REAR
TIRE SIZE	56X16	56X16	56X16	56X16
NO. OF PLYS	24	24	24	24
CONTACT AREA, SQ IN.	309	306	341	314
CONTACT PRESSURE, PSI	113	114	103	112
INFLATION PRESSURE, PSI	100	100	100	100
DEFLECTION, %	38.9	38.1	42.6	40.9

LANE 10

TWIN-TANDEM ASSEMBLY

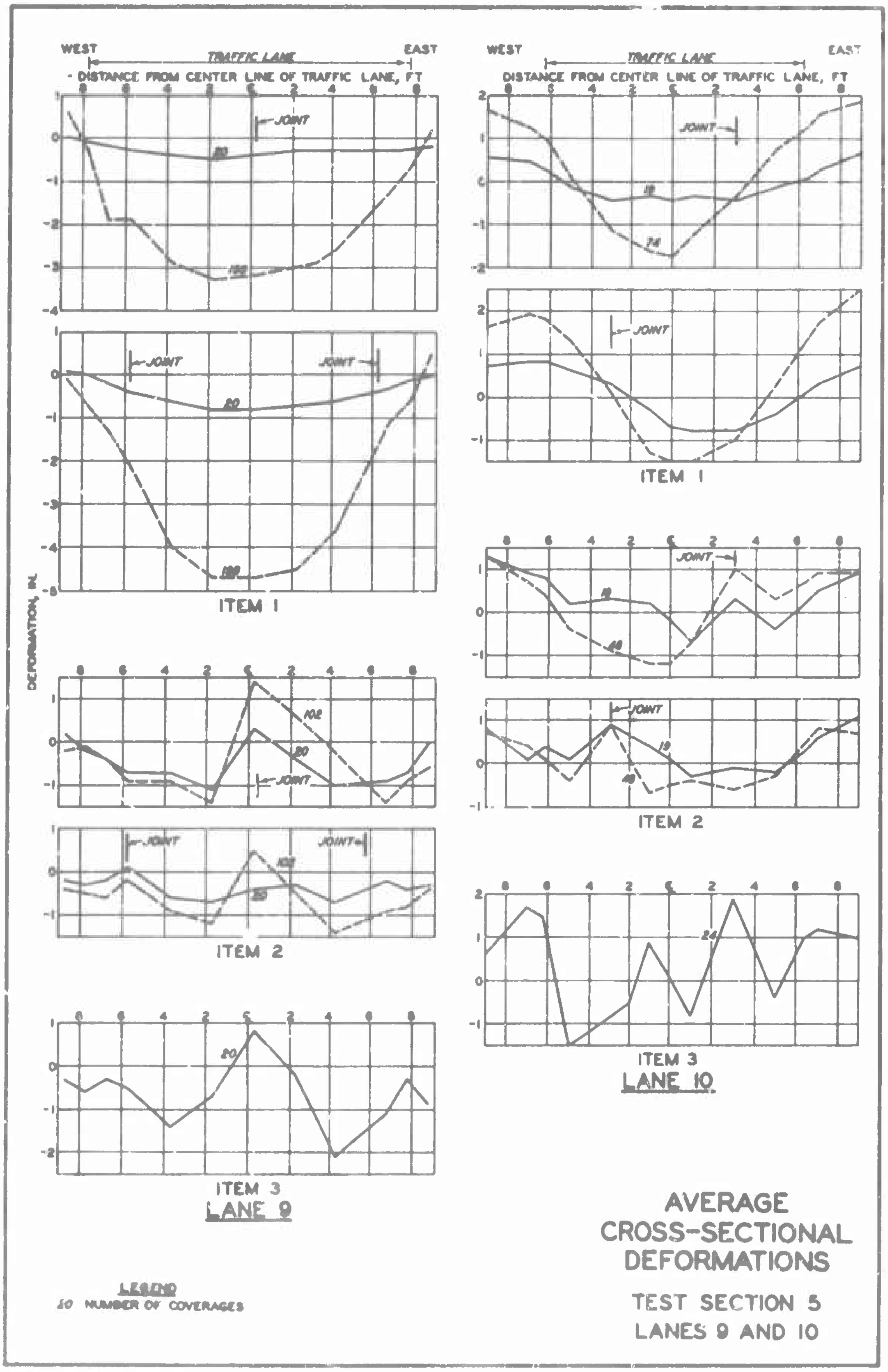
TIRE-PRINT DIMENSIONS AND TIRE CHARACTERISTICS

TEST SECTION 5

LANES 9 AND 10

140-KIP LOAD

Figure 22



WEST
TRAFFIC LANE
EAST
DISTANCE FROM CENTER LINE OF TRAFFIC LANE, FT
JOINT
DEFORMATION, IN.
ITEM 1
ITEM 2
ITEM 3
LANE 9
ITEM 1
ITEM 2
ITEM 3
LANE 10
LEGEND
10 NUMBER OF COVERAGES
AVERAGE
CROSS-SECTIONAL
DEFORMATIONS
TEST SECTION 5
LANES 9 AND 10

Figure 23

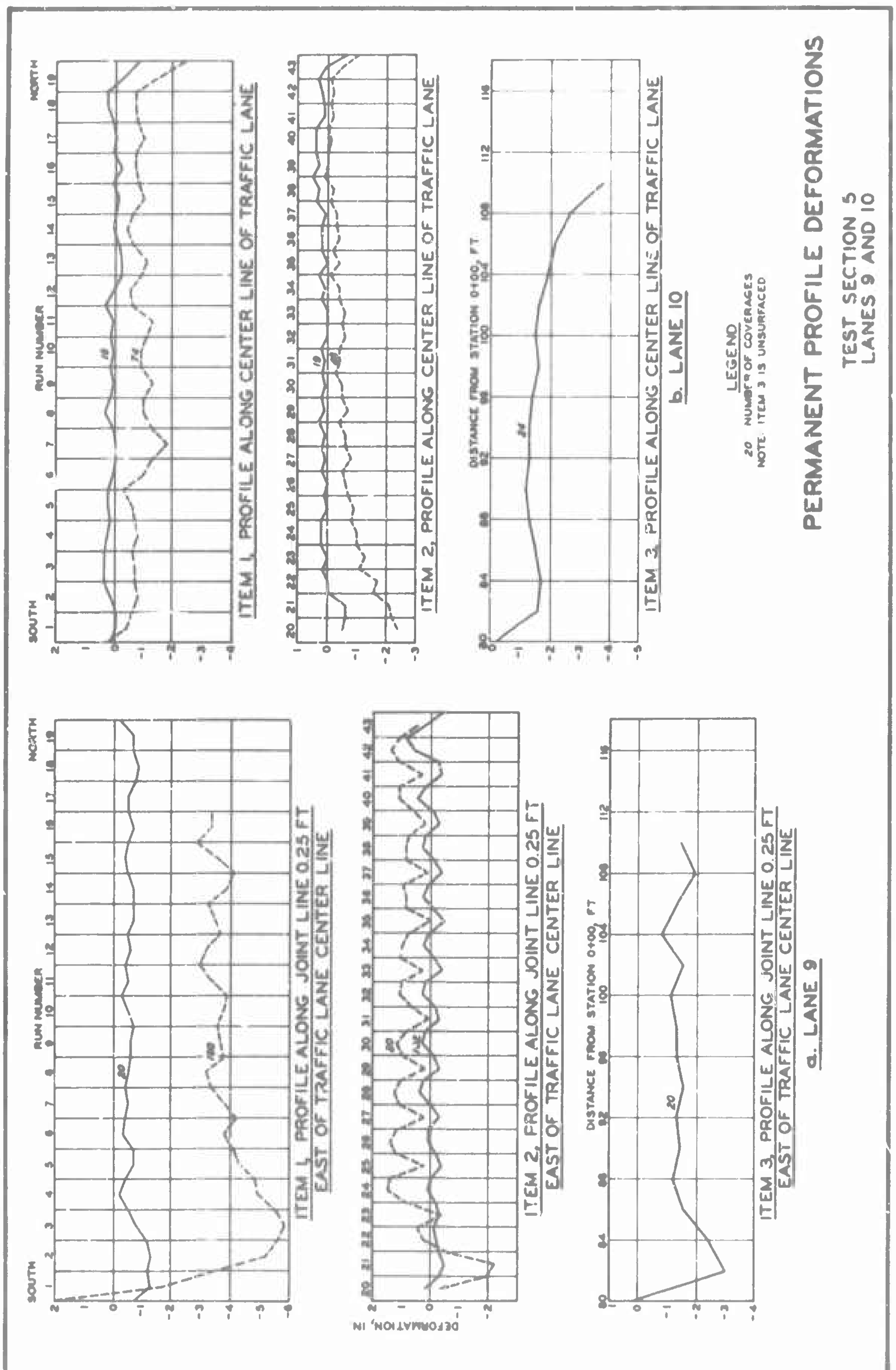
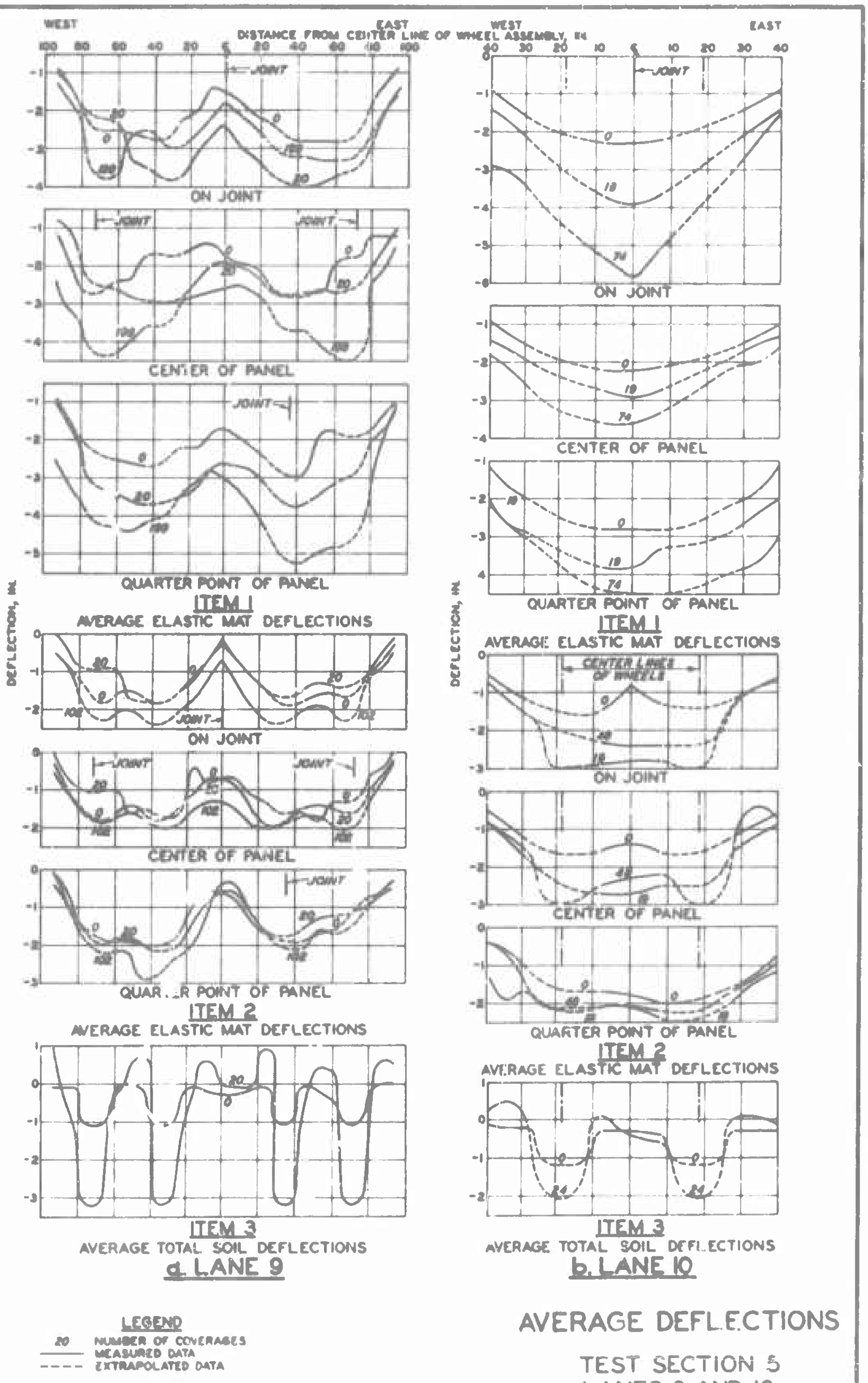

PERMANENT PROFILE DEFORMATIONS
TEST SECTION 5
LANES 9 AND 10
ITEM 1, PROFILE ALONG JOINT LINE 0.25 FT EAST OF TRAFFIC LANE CENTER LINE
ITEM 2, PROFILE ALONG JOINT LINE 0.25 FT EAST OF TRAFFIC LANE CENTER LINE
ITEM 3, PROFILE ALONG JOINT LINE 0.25 FT EAST OF TRAFFIC LANE CENTER LINE
a. LANE 9
ITEM 1, PROFILE ALONG CENTER LINE OF TRAFFIC LANE
ITEM 2, PROFILE ALONG CENTER LINE OF TRAFFIC LANE
ITEM 3, PROFILE ALONG CENTER LINE OF TRAFFIC LANE
b. LANE 10
LEGEND
20 NUMBER OF COVERAGES
NOTE: ITEM 3 IS UNSURFACED
RUN NUMBER
SOUTH
NORTH
DISTANCE FROM STATION 0+00, FT
DEFORMATION, IN

Figure 24



AVERAGE DEFLECTIONS

TEST SECTION 5
LANES 9 AND 10

Figure 25

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3. REPORT TITLE Aircraft Ground-Flotation Investigation Part VI Data Report on Test Section 5	
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6. REPORT DATE AUGUST 1966	7a. TOTAL NO. OF PAGES 29 7b. NO. OF REFS
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Air Force Flight Dynamics Laboratory Research and Technology Division AF Systems Command, WPAFB, Ohio

13. ABSTRACT

This data report describes the results of work undertaken as part of an overall program to develop ground-flotation criteria for the C-5A aircraft.

DD FORM 1 JAN 64 1473

UNCLASSIFIED
Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Aircraft Ground Flotation Rolling Resistance Rear Area Airfields Support Area Airfields Forward Area Airfields Vehicle Mobility						

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